A comparison of spun yarns and filament yarns is given in the following chart.

COMPARISON OF SPUN YARNS AND FILAMENT YARNS

Spun Yarns	*Filament Yarns*
Strength of fibers is not completely utilized.	Strength of fiber is completely utilized.
Have protruding ends.	Long continuous, closely packed strand
1. Dull, fuzzy look	1. Smooth, lustrous
2. Lints	2. Do not lint
3. Subject to pilling	3. Do not pill readily
4. Soil readily	4. Shed soil
5. Warm	5. Cool
6. Loft and bulk depend on the size and twist of yarn.	6. Give little loft or bulk to fabrics.
Are absorbent.	Absorbency depends on fiber content.
1. Good for skin-contact fabric	1. Silk, rayon, acetate are absorbent. Thermoplastics are low in absorbency
2. Resistant to static build-up	2. Static build-up is high in thermoplastics

Yarn Classification

Yarns are classified by size, twist, number of parts, and appearance.

Classification by Size. The size, number, or count of spun yarns and of filament yarns is determined by different systems.

Spun yarn size is expressed in terms of length per unit of weight. It differs according to the kind of fiber. The cotton system is given here. In the cotton system, the count is based on the number of hanks (one hank is 840 yards) in one pound of yarn. Weaving yarns and sewing thread are numbered by this system. The cotton system is an indirect system since the finer the yarn the larger the number. See the following chart.

Number or Count of Spun Yarn	*Hanks*	*Weight*
No. 1	1 (840 yds.)	1 lb.
No. 2	2 (1,680 yds.)	1 lb.
No. 3 etc.	3 (2,520 yds.)	1 lb.

Some examples that show how the size of the weaving yarn affect the weight of the fabric are given in the following chart.

Fabric Weight	*Yarn Size*	
	Warp	*Filling*
Sheer lawn	70s*	100s
Dress weight percale	30s	40s
Suiting weight Indian Head	13s	20s

* The "s" after the number means that the yarn is single

Filament yarn size is dependent partly on the size of the holes in the spinneret and partly on the rate at which the solution is pumped through the spinneret and the rate at which it is withdrawn. The size of filament yarns (and filament fibers) is expressed in terms of weight per unit of length—denier (pronounced "den-yer"). In this system the unit of length remains constant. The numbering system is direct because the finer the yarn the smaller the number.

1 denier	9,000 meters weigh 1 gram
2 denier	9,000 meters weigh 2 grams
3 denier	9,000 meters weigh 3 grams

Classification by Twist. Twist is defined as the spiral arrangement of the fibers around the axis of the yarn. Twist is produced by revolving one end of a fiber strand while the other end is held stationary. Twist binds the fibers together and gives the yarn strength.

DIRECTION. The direction of twist is described as S-twist and Z-twist. These terms have largely replaced the terms "regular," "reverse," "right," and "left," which are used with opposite meaning by various segments of the textile industry. A yarn has S-twist if, when held in vertical position, the spirals conform to the direction of slope of the central portion of the letter "S". It is called Z-twist if the direction of spirals conforms to the slope of the central portion of the letter "Z". Z-twist is the standard twist used for weaving yarns. (See Figure 10–18.)

AMOUNT. The amount of twist varies with the length of the fibers, the size of the yarn, and the intended use. Increasing the amount of twist up to a certain point will increase the strength of the yarns. Too much twist places the fibers at right angles to

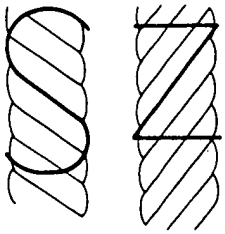


Fig. 10–18. S and Z twist.

the axis of the yarn and causes a shearing action between fibers and the yarn will lose strength. (See Figure 10–19.)

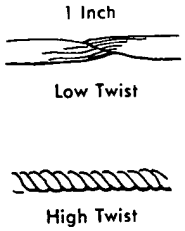


Fig. 10–19. Diagram showing high and low twist.

Yarns with long fibers do not require as much twist as yarns with short fibers, since they establish more points of contact per fiber and give stronger yarn for the same amount of twist. Fine yarns require more twist than coarse yarns. Knitting yarns have less twist than the filling yarns used in weaving. It is important for knitting yarns to be very uniform to prevent the formation of thick and thin places in the fabric. The chart and the discussion that follow give some examples of different amounts of twist.

AMOUNT OF TWIST

Amount	*Example*
Low twist	Filament yarns; 2 to 3 t.p.i.*
Napping twist	Blanket warps; 12 t.p.i. Filling; 6 to 8 t.p.i.
Average twist (Usually spun yarn)	Percale warps; 25 t.p.i. Filling; 20 t.p.i. Nylon Hosiery; 25 to 30 t.p.i.
Voile twist	Hard twist singles; 35 to 40 t.p.i. are plied with 16 to 18 t.p.i.
Crepe twist	Singles; 40 to 80 or more t.p.i. are plied with 2 to 5 t.p.i.

* Turns per inch.

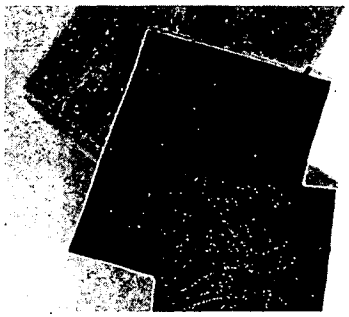
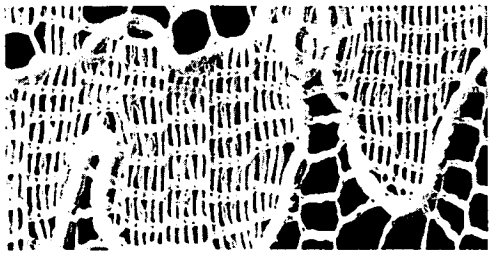
Low twist is used in filling yarns of fabrics that are to be napped. The low twist permits the napping machine to tease out the ends of the staple fibers and create the soft fuzzy surface. (See "Napping," page 170.)

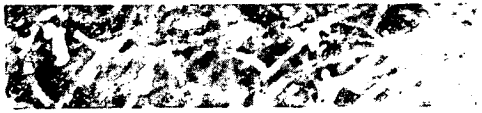
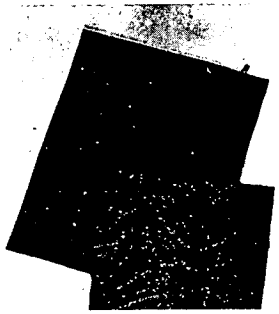
Average twist is that most frequently used for yarns made of staple fibers and is very seldom used with filament yarns. The amount of twist that gives warp yarns maximum strength is referred to as standard warp twist. Warp yarns need more twist than filling yarns because warp yarns are under high tension on the loom and they must resist wear caused by the abrasion of the shuttle moving back and forth. The lower twist of the filling yarns makes them softer and less apt to kink.

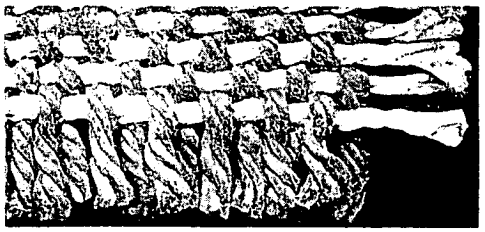
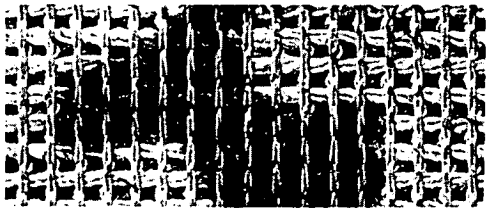
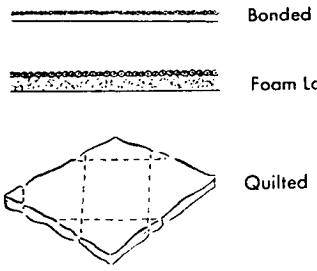
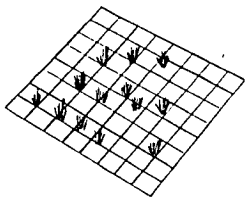
High, hard twist (voile twist) yarns have 30 to 40 turns per inch. The hardness of the yarn results when twist brings the fibers closer together and makes the yarn more compact. This effect is more pronounced when a twist-on-twist ply yarn is used. Twist-on-twist means that the direction of twist in the singles is the same as the direction of plying twist. (See Figure 10–20.) This results in a build-up of the total amount of twist in the yarn. (See "Voile," page 140.)

Fig. 10–20. Twist on twist yarn.

Crepe yarns are made of either staple or filament fiber. They are made with a high number of turns per inch (40 to 80) inserted in the yarn. This makes the yarn so lively and kinky that it must be twist-set before it can be woven or knitted. *Twist-setting* is a finishing process in which the yarns are moistened and then dried in a straightened condition. After weaving, the cloth is moistened and the yarns become lively and kinky once more and thus produce the crinkle characteristic of true crepe fabrics. All of the common *natural* fibers and rayon can be used in crepe twist yarns because they can be twist-set in water. The thermoplastic fibers are not used in high-twist crepe yarns because they are not affected by water; and if the twist is set by heat, the liveliness of the twist is deadened. Increasing the amount of crepe yarn twist and alternating the direction of twist will increase the amount of crinkle in a crepe fabric. For example, 6S and 6Z will give a more prominent crinkle than 2S and 2Z.

Method	*Simple Description*	*Diagram or Photograph of Typical Fabric*	*Major Characteristics*	*Reference*
Felting	Wool fibers are carded (and combed), laid down in a thick batt, sprayed with water, and run through hot agitating plates, which cause the fibers to become entangled and matted together.	 Fig. 13–3. Felt.	No grain. Does not fray or ravel. Absorbs sound.	Page 116
Nonwoven (Fiber web)	Fibrous sheets are produced by bonding and/or interlocking textile fibers by mechanical, chemical, thermal, or solvent means or combinations of these processes.	 Fig. 13–4. Nonwoven fabric.	Cheaper than woven or knitted fabrics. Widely used for disposable items. May have grain but usually do not.	Page 117
Films	Solution is extruded through narrow slits into warm air or cast onto a revolving drum. Moulding powders may be pressed between hot rolls.	 Fig. 13–5. Films.	Waterproof. Low cost. Resistant to soil. Finished to look like leather, lace, woven fabrics, etc.	Page 123
Lace	Yarns are knotted, interlaced, interlooped, or twisted to form open-work fabrics, usually with some figures.	 Fig. 13–6. Lace.	Decorative edgings, insertion, or entire fabric.	(Not included in text)
Braid	Yarns are interlaced lengthwise and diagonally.	 Fig. 13–7. Braid.	Narrow fabrics used for trimming. Circular braids good for shoe laces.	(Not included in text)

Method	*Simple Description*	*Diagram or Photograph of Typical Fabric*	*Major Characteristics*	*Reference*
Felting	Wool fibers are carded (and combed), laid down in a thick batt, sprayed with water, and run through hot agitating plates, which cause the fibers to become entangled and matted together.	 Fig. 13–3. Felt.	No grain. Does not fray or ravel. Absorbs sound.	Page 116
Nonwoven (Fiber web)	Fibrous sheets are produced by bonding and/or interlocking textile fibers by mechanical, chemical, thermal, or solvent means or combinations of these processes.	 Fig. 13–4. Nonwoven fabric.	Cheaper than woven or knitted fabrics. Widely used for disposable items. May have grain but usually do not.	Page 117
Films	Solution is extruded through narrow slits into warm air or cast onto a revolving drum. Moulding powders may be pressed between hot rolls.	 Fig. 13–5. Films.	Waterproof. Low cost. Resistant to soil. Finished to look like leather, lace, woven fabrics, etc.	Page 123
Lace	Yarns are knotted, interlaced, interlooped, or twisted to form open-work fabrics, usually with some figures.	 Fig. 13–6. Lace.	Decorative edgings, insertion, or entire fabric.	(Not included in text)
Braid	Yarns are interlaced lengthwise and diagonally.	 Fig. 13–7. Braid.	Narrow fabrics used for trimming. Circular braids good for shoe laces.	(Not included in text)

Weaving	Two or more sets of yarns are interlaced *at right angles* to each other.	 Fig. 13–8. Plain-weave woven fabric.	Fabrics have grain. Sides can be raveled. Fabrics may ravel. Many different interlacing patterns give interest to fabrics. Most widely used fabric construction technique.	Chapters 15, 16, 17
Knitting	One or more yarns are formed into a series of interlocking loops.	 Fig. 13–9. Knitted.	Faster technique than weaving. Very pliable and stretchy. Wrinkle-resistant.	Chapter 14
Knit-sew (Malimo)	A layer of warp yarns is placed over a layer of filling yarns (not interlaced) and the two layers are locked together with a chain stitch.	 Fig. 13–10. Malimo, knit-sew.	Inexpensive construction technique because of speed of process.	Chapter 21
Multi-component	Components (fabrics, foams, films) are held together by quilting (machine stitched), adhesive or foam-flame bonding, embossing, or other techniques.	 Fig. 13–11. Multicomponent.	Lightweight fabrics can be used for outer wear. Lower cost than double-woven or knitted cloth. Lining and face as one shortens garment production time and therefore the cost. Warmth without weight.	Page 176
Tufting	Yarns carried by needles are forced through an already made fabric and formed into cut or uncut loops.	 Fig. 13–12. Tufted.	Cheaper than woven pile fabrics because of speed of production.	Page 165